Device for measuring an impact force applied to an object.

The present invention relates to a device for measuring an impact force applied to an object, for use particularly, but not exclusively, for calculating the speed of an object used in a sports game.

Many sports are based on the movement of an object, most commonly a ball. Recent technology has allowed the speed at which these balls travel to be known. This provides an added interest for both the players and the viewers, for example, the fastest serve in Tennis, or the fastest pitch in Baseball.

The technology used to record the speed of a ball is based on measurements taken as the ball passes through space, for example with a known type of infrared or laser "speed gun". This kind of technology is sophisticated and expensive, and is therefore not available to the amateur enthusiast.

Further, this equipment may require a user who is not participating in the game who can aim the device at the moving ball.

The present invention is intended to provide an alternative approach.

According to the present invention a measuring device comprises pressure measuring means adapted to be fitted to a first sports implement and further adapted to record the contact pressure between the first sporting implement and a second sports implement in use, and means to communicate the pressure calculated to the user.

The measuring device may be further provided with processing meanswhich is provided with means to derive a pre-determined value on a scale from a contact pressure recording received in use, and in which the pre-determined value is communicated to the user.

It will be appreciated that this means to derive a pre-determined value on a scale could be a programmed equation. However, in a preferred construction the means to derive a pre-determined value is a database of potential contact pressure recordings, in which each potential contact pressure recording corresponds to a pre-determined value on the scale, and when a contact pressure recording is received in use, the corresponding pre-determined value is communicated to the user.

The pre-determined scale can be 0 to 100, in which the lowest pressure recordable corresponds to 0 and the highest pressure recordable corresponds to 100. With this arrangement a score on the scale from 0 to 100 can be provided which corresponds to the force with which the first sporting implement contacted the second sporting implement.

However, in a preferred construction the pre-determined value is a speed on a speed scale which substantially corresponds to the speed at which the second sports implement was travelling before and/or after is impacted the pressure measuring means.

In a first construction the first sports implement can be a striking object, for example a soccer boot, a baseball bat, or anything similar, and the second sports implement can be an object which is struck, for example

a soccer ball or a baseball. It will be appreciated that with this arrangement it is the speed of the ball after it was struck by the boot or the bat which is communicated.

In an alternative construction the first sports implement can be an object which is struck, for example a baseball glove, and the second sports implement can be a striking object, for example a baseball. It will be appreciated that with this arrangement it is the speed of the ball upon impact with the glove which is communicated.

The pressure measuring means can be any device which can detect a change in pressure, for example a transducer sensor of a known type, for example a strip of piezoelectric crystal, which is adapted to provide an electrical signal to the processing means when a physical pressure is created between the two sports implements in use.

However, in an alternative construction a Quantum Tunnelling Composite (QTC) manufactured by Peratech, of G3 Morton Park Way, Dalington, County Durham, Great Britain, is used.

QTCs are electrically conductive composite solid state materials which change from an insulator to conductor when physically manipulated, and are used in switches, variable resistance controls and sensors that respond to force, temperature or volatile organic compounds.

Current can pass between conductor particles within the composites that are not in physical contact by means of electron tunnelling. The dependence of tunnelling current upon conductor particles separation is

exponential, therefore an enormous resistance range can be controlled by relatively small changes in separation.

Under pressure or mechanical deformation the resistance of a QTC drops gradually over a range from greater than 10 exp(12) ohms to less than one ohm (ie the QTC turns from an insulator to a conductor). The electrical resistance changes smoothly and controllably.

Operating pressures can be extremely large or small ie from the hardest hammer blow to the lightest touch, and the proportional resistance range can be fully pre-determined.

As a result a QTC can provide a very accurate measurement of a contact pressure between two sporting implements, which allows an accurate speed to be calculated.

In addition, QTC can be provided in granular form, which can be put into or onto other surfaces or materials to impart its electrical properties to that surface or material.

The processing means can be an electronic circuit constructed from known materials and to a known formula. The circuit can be programmable, so it can be provided with one or more of the above described databases.

The communication means can be a visual display, which is provided on the measuring device. The visual display can be a liquid crystal display. In an alternative construction the communication means can be an audio signal, for example a recording of a voice speaking the speed recorded.

The communication means can also be provided on a second base, connected to the processing means by a remote signal. In one construction the communications means can be provided on a watch, which can either display, or audibly communicate the speed calculated once the remote signal is sent to it.

The processing means and/or the LCD can be provided on the opposite side of the device to the pressure measuring means, and therefore the opposite side of the sports implement to the side of impact.

The invention can be performed in various ways but three examples will now be described by way of example and with reference to the accompanying drawings in which:

Figure 1 is a perspective view of the component parts of a measuring device according to the present invention;

Figure 2 is a perspective view of the device shown in Figure 1;

Figure 3 is a perspective view of the device shown in Figure 2 fitted to a football boot,;

Figure 4 is a perspective view of a second measuring device according to the present invention;

Figure 5 is a perspective view of the device shown in Figure 4 fitted to a baseball glove,

Figure 6 is a further perspective view of the device shown in Figure 4 fitted to a baseball glove,

Figure 7 is a cross sectional side view of a section of the second measuring device as shown in Figure 4,

Figure 8 is a side view of a third measuring device according to the present invention;

Figure 9 is an end view of the third measuring device as shown in Figure 8; and,

Figure 10 is a flow chart which shows the operational stages of any of the devices shown in Figures 1 to 9.

In Figures 1, 2, and 3 a measuring device 1 is adapted to be fitted to a soccer boot 2. The device 1 comprises a transducer sensor 3 which is adapted to record the contact pressure between the soccer boot 2 and a soccer ball (not shown), an electronic circuit board 4 adapted to calculate from the pressure recorded by the transducer 3 the speed at which a soccer ball was travelling after it was struck by the boot 2, and an LCD display 5 to display the speed calculated.

The device 1 further comprises a base 6, a foot strap 7, a heel strap 8, a housing 9 and a resilient outer cover 10. The transducer 3 is secured to the base 6, and is provided with a cover 11. The outer cover 10 is secured on the base on top of the transducer 6. The housing 9 comprises a base 12 and an outer cover 13. The circuit board 4, the LCD display 5 and a battery 14 are contained within the housing 9. The base 12 is provided

with an opening 15 and a removable cover 16, though which the battery 14 can be removed and/or replaced. The housing 9 is secured to the heel strap 8, and the heel strap 8 and the foot strap 7 are secured to the base 6 by means of pivot joints 17 and 18.

The transducer 6 is disposed in an off-set position on the base 6, which corresponds to the spot where a soccer ball is traditionally struck by a soccer boot.

As shown in Figure 3 the device 1 is fitted to a soccer boot 2 by placing the base 6 on the upper 19 of the boot 2, and placing the foot strap 7 around the body 20 of the boot 2, and the heel strap 8 around the heel 21 of the boot 2. The device 1 can be provided with an operating switch (not shown) to turn it on.

In use the operator fits the device 1 to their soccer boot, and switches it on. They then strike a soccer ball in the traditional manner. As a result the transducer 3 is placed under a contact pressure and a measurement is taken. This measurement is sent to the electronic circuit board 4 via insulated wire 22 (as shown in Figure 1). The circuit board 4 is programmed with a database of potential pressure measurements, which includes the speed figure to be displayed when a particular pressure measurement is received, and the result is then displayed on the LCD display 5. It will be appreciated that the speed displayed will only be accurate if the resilience of the ball corresponds to information about the ball which has also been programmed into the circuit 4. It will be further appreciated that the device 1 will only provide an accurate reading if the ball is struck by the portion of the boot 2 adjacent to the transducer 3.

To assist in the accurate use of the device 1 a pattern 23 is displayed on the outer cover 10 which shows where a ball should be struck by the foot.

As shown in Figure 3 the housing 9 is on the opposite side of the boot to the striking area 24. With this arrangement the housing 9 will not be damaged when the boot comes into contact with the ball.

It will be appreciated that the above described device 1 can be adapted to be used with any sporting implement which is used to strike another sporting implement, without departing from the invention.

In Figures 4, 5 and 6 a measuring device 25 is adapted to be fitted to a baseball glove 26.

The device 25 comprises a layer of Quantum Tunnelling Composite (QTC), of the type manufactured by Peratech, of G3 Morton Park Way, Dalington, County Durham, Great Britain (not visible in Figures 4, 5 and 6) which is adapted to record the contact pressure between the glove 26 and a baseball ball (not shown), an electronic circuit board (not visible) adapted to calculate from the pressure recorded by the QTC the speed at which a ball was travelling before it was caught by the glove 26, and an LCD display 27 to display the speed calculated.

The device 25 operates in substantially the same way as device 1 shown in Figures 1, 2 and 3. The device 25 comprises a base 28, upon which the layer of QTC is mounted, and covered by an outer cover 29. A housing 30 is provided which contains the circuit board, battery and LCD display 27 required to operate the invention.

In use the device 25 is fitted to a glove 26 by means of straps 31. The housing 30 is secured to the rear of the wrist portion 32 of the straps 31. The user activates the device 25 by means of switch 33, then catches a flying ball. The contact pressure recorded by the layer of QTC is then sent to the circuit, and a speed is calculated and displayed on the LDC display.

As shown in Figure 6 the housing 30 is on the opposite side of the glove to the ball catching area, so it will not be damaged in use.

As shown in Figure 7 a layer of foam 34 is disposed between the base 28 and the outer cover 29. QTC in granular form has been applied to the foam 34, which acts as a carrier material, and positive 35 and a negative 36 electrical points are in contact with the foam 34. Therefore, when a ball (not shown) puts pressure on the outer cover 29, the foam 34 is distorted between the outer cover 29 and the glove 26, and a reading can be taken.

The device 25 can be altered without departing from the spirit of the invention. In particular, in another embodiment (not shown) the device is not provided with straps 31, rather it is provided with internal resilient means adapted to bias the front and rear portions of the device together, thereby to hold it in placed on the web between the thumb and finger portions of a glove.

In Figures 8 and 9, a baseball bat 40 is provided with a foam sleeve 41, which carries a QTC in a similar manner to the foam 34 shown in Figure 7. The bat 40 is also provided with a display 42 at its inner end 43. As

shown in Figure 9 the display 42 comprises an LCD 44, and an operation button 45 is also provided.

An electronic circuit (not shown) and a battery are provided inside the bat, and are connected to the foam sleeve 41.

In use the bat is switched on by means of the button 45, and the bat can be switched between three modes. In a first mode, which is indicated by arrow 46 in the LCD 44, the bat is set for striking a softball. In a second mode the LCD displays the highest speed recorded, and in a third mode, the bat is set for striking a baseball. The electronic circuit is programmed with two databases, one with pressure recordings which correspond to a softball, and one with pressure recordings corresponding to a baseball. Which database is used depends on whether the first or the third mode is set, and the result is then displayed on the LCD display 44. Due to the nature of the QTC, an accurate pressure reading can be taken regardless of where the ball is struck on the foam sleeve 41.

The bat 40 can be altered without departing from the spirit of the invention. In particular, in an alternative embodiment (not shown) the foam sleeve can be removed from the bat, and the electronic circuit, the battery and the display can be provided in a module, which can also be removed from the bat. Thus a device can be provided which can be fitted to a conventional bat.

In a further alternative embodiment (not shown) a layer of QTC is formed into a lattice formation, from which it can be determined where on the layer a contact has been made. Therefore, a device can be fitted to a

boot, glove or bat and so on, which can also provide information in relation to the location of a hit or catch.

It will be appreciated that baseballs, and other balls, can be provided with protruding elements, for example seams. Therefore, different pressure readings can be recorded depending on whether a smooth portion or a protruding portion of the ball is struck or caught. Therefore, in a further alternative embodiment (not shown) the electronic circuit can be provided with two or more databases which correspond to different parts of a ball being struck, and can be adapted to recognise from the pressure recordings received which part of a ball has been struck, and to utilise the correct database to calculate the speed.

Figure 10 shows a flow chart which explains the basic operation of any of the above described devices.

It will be appreciated that any of the above described devices can be adapted to be used with any sporting implement which is used to stop or catch another sporting implement, without departing from the spirit of the invention.

Thus a device is provided which is cheap to manufacture and to purchase, and which can be used to calculate the speed of sporting implements without the need for a third party using a separate measuring device.